Question 1 [9 + 6 Marks]

(A) [9 Marks] Write a non-member function **sumOpposite** that has two parameters **st1** and **st2** of type **stackType**. The stack **st2** is initially empty. The function adds the first inserted element (bottom element) and the last inserted element (top element) of **st1** and pushes the result in **st2**. The function continue the same process by computing the summation of the second inserted element in **st1** and the element inserted before the last in **st1**, and pushing the result in **st2**, and so on.

The function returns false if **st1** is empty, else the function returns true at the end. Assume that **st1** has even number of elements and you need not have to check for that. All the elements of **st1** should be in the original relative order.

Assume that class **stackType** is available for use. Use only common stack operations such as push, pop, top, isEmptyStack, isFullStack, operator= and copy constructor.

Function prototype:

```
bool   sumOppsite(stackType<Type>& st1, stackType<Type>& st2);
```

Example:

Stack st1 :   1 3 4 12 8 6 2 5
top

Stack st2 after function call :   20 10 5 6
top

Note that 1 + 5 = 6, so first push 6 in st2.

Next, 3 + 2 = 5, so push 5 in st2.

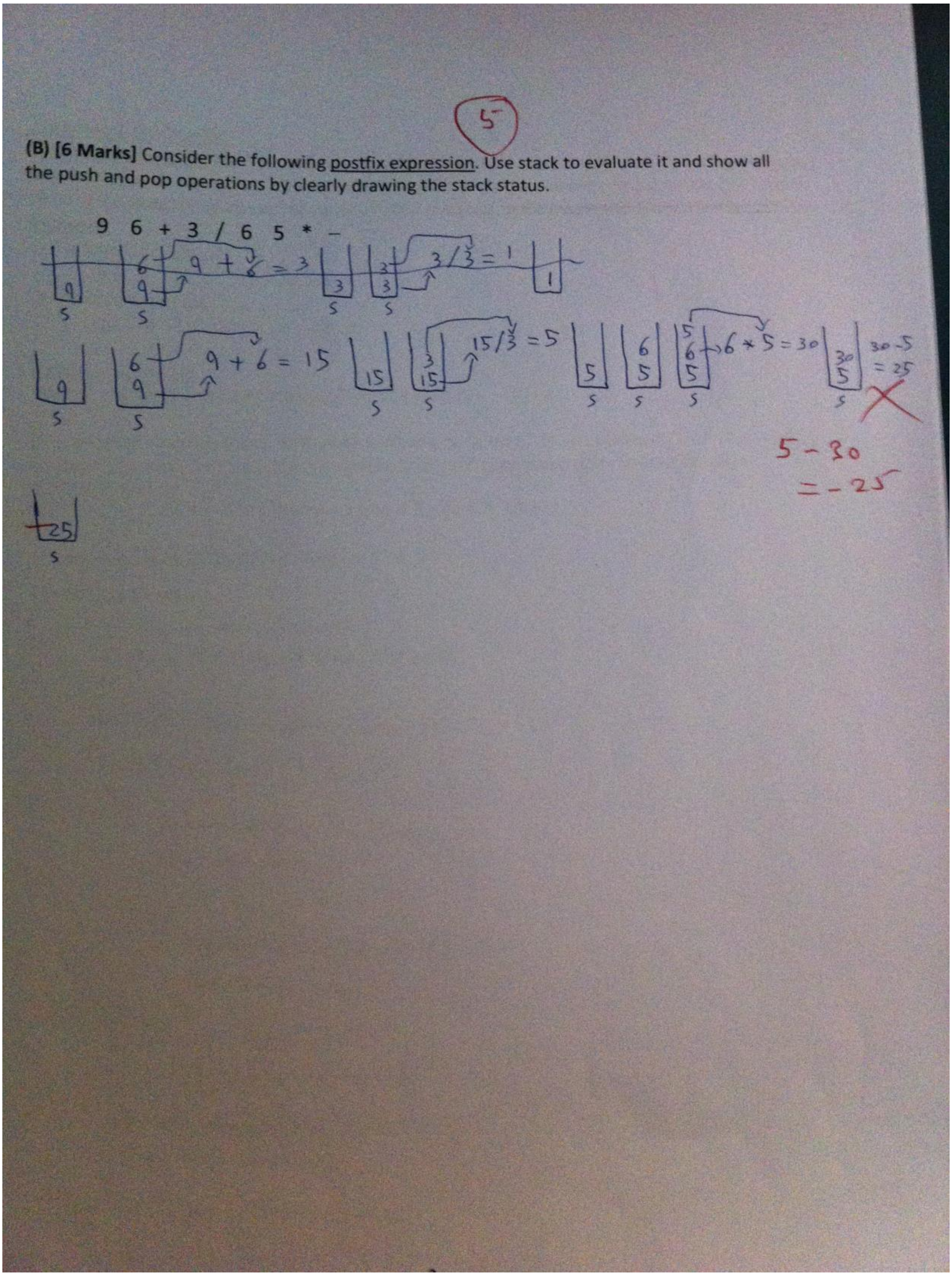
Next 4 + 6 = 10, so push 10 in st2.

Finally, 12 + 8 = 20, so push 20 in st2.

```
     template <class Type>
bool   sumOppsite( stackType<Type> & st1, stackType<Type> & st2)
{   if( st1.isEmptyStack()) Return false;
  stackType<Type> st3, temp(st1);
  while( ! temp.isEmptyStack())
  {
      st3.push( temp.top());
       temp.pop();
  }
  temp = st1;
  Type R;
 while( ! temp.isEmptyStack())
 {
   R = temp.top() + st3.top();
   st2.push(R);
   st3.pop();
   temp.pop();
 }
 Return true;
}
```

You Should have half way

7½



5

(B) [6 Marks] Consider the following postfix expression. Use stack to evaluate it and show all the push and pop operations by clearly drawing the stack status.

9 6 + 3 / 6 5 * −

~~9 + 6 = 3~~ ~~3/3 = 1~~

9 + 6 = 15

15/3 = 5

6 * 5 = 30

30-5 = 25

25

5 − 30 = −25

Question 2 [10 Marks]

Write a non-member function called **negativeFirst** that receives a queue object ***Qu*** of type **queueType** as parameter. The function takes all negative elements found in ***Qu*** and places them at the front of the queue, the order of other elements in the queue will remain unchanged.

Example:

Qu before function call:

```
    Qu: 2 -5 7 -12 -20 22 4
```

Qu after function call:

```
    Qu: -5 -12 -20 2 7 22 4
```

10

Function prototype:

```
void  negativeFirst(queueType<Type>&   Qu);
```

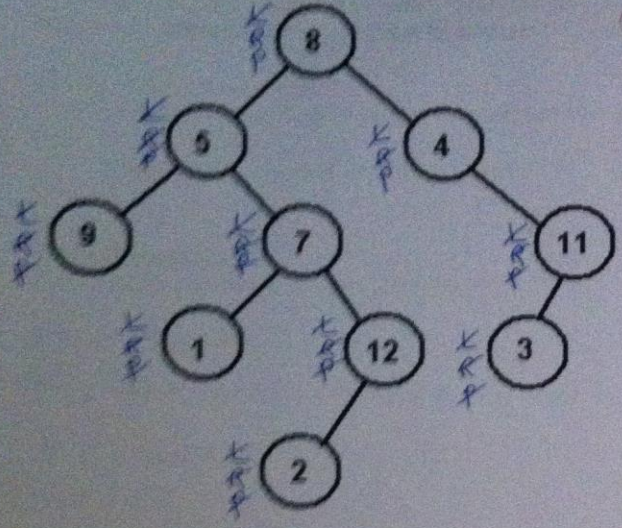
You may use common queue operations such as `addQueue`, `deleteQueue`, `front`, `back`, `isEmptyQueue`, `isFullQueue`, `operator=` and copy constructor in your function.

```
template <class Type>
void negativeFirst(queueType<Type>& Qu)
{
    queueType<Type> neg , pos;
    ~~While( Qu~~
    if ( Qu.isEmptyQueue())
      cout<<" Empty Queue "<<endl;
    else{
     While( ! Qu.isEmptyQueue())
     {
        if ( Qu.front() >=0)
        {
           Pos.addQueue( Qu.front());
           Qu.deleteQueue();
        }
        else{
             neg.addQueue (Qu.front());
             Qu.deleteQueue();
           }
     }
    While(!neg.isEmptyQueue())
    {
       Qu.addQueue(neg.front());
       neg.deleteQueue();
     }
    While( !pos.isEmptyQueue())
    {
       Qu.addQueue(pos.front());
       Pos.deleteQueue();
    }
  }
}
```

Question 3 [8 + 7 Marks]

(A) For the binary tree given below, answer the following questions:

15



i. **[1 Marks]** What is the **height** of this binary tree?

5 1

ii. **[2 Marks]** List all the leaf nodes of this binary tree.

9,1,2,3 2

8

iii. **[5 Marks]** List the sequence of nodes, if the binary tree is traversed using **post-order traversal**.

~~9 1 2 12 7~~

9,1,2,12,7,5,3,11,4,8

5

(B) [7 Marks] Write a recursive private member function called `countLeaves` to be included in class `binaryTreeType`. The function counts the number of leaf nodes in the binary tree and returns this count. This function is called from a public member function `treeCountLeaves`, given as follows:

```
template<class Type>
int  binaryTreeType<Type>::treeCountLeaves( )
{
     return    countLeaves( root );
}
```

<u>Function prototype:</u>

```
int  countLeaves(nodeType<Type>  *p);
```

```
template <class Type>
int binaryTreeType<Type>::countLeaves( nodeType<Type> *p)
{
     if ( p == NULL)
       return 0;
     else if ( p->lLink == NULL && p->rLink == NULL)
          return 1;
     else
       return 0 + countLeaves( p->lLink) + countLeaves( p->rLink);
}
```

α

7